Public Health Nutrition: 19(6), 958–966 doi:10.1017/S1368980015001731

Sodium in commonly consumed fast foods in New Zealand: a public health opportunity

Celia A Prentice[1], Claire Smith[1] and Rachael M McLean[1,2,*]
[1]Department of Human Nutrition, University of Otago, PO Box 56, Dunedin, New Zealand: [2]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, Otago, New Zealand

Submitted 22 January 2015: Final revision received 1 April 2015: Accepted 21 April 2015: First published online 3 June 2015

Abstract

Objective: (i) To determine the Na content of commonly consumed fast foods in New Zealand and (ii) to estimate Na intake from savoury fast foods for the New Zealand adult population.
Design: Commonly consumed fast foods were identified from the 2008/09 New Zealand Adult Nutrition Survey. Na values from all savoury fast foods from chain restaurants (*n* 471) were obtained from nutrition information on company websites, while the twelve most popular fast-food types from independent outlets (*n* 52) were determined using laboratory analysis. Results were compared with the UK Food Standards Agency 2012 sodium targets. Nutrient analysis was completed to estimate Na intake from savoury fast foods for the New Zealand population using the 2008/09 New Zealand Adult Nutrition Survey.
Setting: New Zealand.
Subjects: Adults aged 15 years and above.
Results: From chain restaurants, sauces/salad dressings and fried chicken had the highest Na content (per 100 g) and from independent outlets, sausage rolls, battered hotdogs and mince and cheese pies were highest in Na (per 100 g). The majority of fast foods exceeded the UK Food Standards Agency 2012 sodium targets. The mean daily Na intake from savoury fast foods was 283 mg/d for the total adult population and 1229 mg/d for fast-food consumers.
Conclusions: Taking into account the Na content and frequency of consumption, potato dishes, filled rolls, hamburgers and battered fish contributed substantially to Na intake for fast-food consumers in New Zealand. These foods should be targeted for Na reduction reformulation.

Keywords
Sodium
Salt
Fast foods
Takeaway
New Zealand
Nutrition Survey

Na is widely used as a food additive in processed foods to preserve, enhance flavour and palatability[1]. Between 75 and 80 % of Na intake in the Western diet is from processed foods[2] and therefore reducing Na in these foods through reformulation has great potential to reduce Na intakes[3]. Identifying the types of foods that contribute most to Na intake is important for tailoring the development of appropriate Na reduction strategies[4,5]. Fast foods/takeaway foods are of particular interest given that they have been found to be high in Na/salt in many countries[6–8]. New Zealand sales data suggest that fast-food consumption increased by 10 % between 1999 and 2008[9]. Results from the most recent New Zealand Adult Nutrition Survey in 2008/09 (NZANS) show that fast food is an important source of energy for some population groups (particularly young adults aged 19–30 years) and that some types of fast foods (such as hamburgers and hot chips) are more commonly consumed than others[10]. Furthermore, consumers may not be aware of the amount of Na in takeaway and restaurant foods, and are unlikely to identify this type of food as an important contributor to overall intake[11].

The New Zealand and Australian governments have jointly determined a Suggested Dietary Target (SDT) of 1600 mg Na/d and an Upper Level (UL) of 2300 mg Na/d to aid in the prevention of chronic disease[12]. The most recent estimate of Na intake in New Zealand, determined by 24 h urine samples collected in 2012, was 3400 mg/d[13]. This is substantially above current recommendations. The WHO is supporting governments to implement the Global Action Plan for the Prevention and Control of Non-communicable Diseases, which would result in a 30 % reduction in salt intake (to achieve a mean intake of less than 2000 mg Na/d (5 g salt/d)) by 2025 in participating countries[14]. This is because high dietary Na intakes are

**Corresponding author:* Email Rachael.mclean@otago.ac.nz
© The Authors 2015

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

associated with high blood pressure[15], the leading preventable risk factor for death (attributable to CVD, stroke and related conditions) worldwide[16]. An estimated 2·5 million deaths could be averted globally each year if this target were achieved[17]. Surveillance of dietary Na intakes and evaluation of interventions is vital to achieving this recommendation.

Population Na reduction strategies have been identified as one of the most effective and cost-effective public health strategies available to prevent chronic disease[18,19]. The combination of food reformulation with improvements in food labelling and consumer education implemented in the UK by the Food Standards Agency (FSA) has resulted in a 10 % reduction in mean population salt intake (from an average of 9·5 g/d in 2000–2001 to 8·1 g salt/d in 2011)[20]. In New Zealand the National Heart Foundation, funded by the Ministry of Health, has worked in collaboration with the food industry to reduce the Na content of bread[21] and some other manufactured foods[22]. However, the contribution of takeaway or fast foods to population Na intake has not been determined and the feasibility of Na reduction in this food group is unknown.

Therefore, the overall aims of the present study were to: (i) determine the Na content (per serving and per 100 g) of commonly consumed fast foods (from independent outlets and chain restaurants) in New Zealand and compare them with the UK FSA 2012 sodium targets; and (ii) estimate Na intake from savoury fast foods for the New Zealand adult population.

Methods

In summary, data were obtained from three main sources:

1. Results from the 24 h diet recall of the 2008/09 NZANS were used to identify the most commonly consumed fast foods for analysis. These data were also used for estimation of population Na consumption from savoury fast foods.
2. Of the commonly consumed savoury fast foods identified above, for food categories (n 16) that were usually sourced from chain restaurants, we identified and recorded nutrition information from company websites.
3. For food categories (n 12) that were usually sourced from independent food outlets, samples of food were purchased and analysed in the laboratory for Na content.

Methods of the 2008/09 New Zealand Adult Nutrition Survey

Sampling

The 2008/09 NZANS was a nationally representative, cross-sectional survey of 4721 New Zealand adults (aged 15 years and over)[23]. Participants were recruited using a three-stage, stratified, area-based sampling frame and there was an overall response rate of 61 %. Increased sampling of Māori and Pacific Island ethnic groups and some age categories (15–18 years and ≥71 years) occurred to achieve adequate numbers for robust age and ethnicity comparisons. Participants were drawn from urban and rural regions, but were restricted to persons living in private dwellings[23]. Informed, written consent was obtained. The New Zealand Health and Disability Multi-Region Ethics Committee granted ethical approval for the survey (MEC/08/04/049).

Dietary data collection

Dietary intake data were collected through a computer-assisted, multiple-pass 24 h diet recall administered by a trained interviewer[23]. The recall interview was structured in four phases. The initial phase was a 'quick list' of all foods, beverages and dietary supplements consumed in the preceding day (midnight to midnight). At this stage, participants were also asked where they sourced the food[23]. Participants could choose from several options including: (i) store/shop/market; (ii) restaurant/café; (iii) fast-food/takeaway outlet; (iv) workplace (cafeteria, catering); (v) vending machine; (vi) other (community food programme, gift, online purchases); and (vii) home/domestic (home-grown produce). Participants who reported at least one food or beverage sourced from a fast-food/takeaway outlet in the 24 h recall were classified as a 'fast-food consumers'[10]. In the next stage, detailed descriptions of all foods and beverages on the quick list were collected using computer-controlled questions and prompts specific to each item (including the cooking methods used, recipes for mixed dishes, additions made 'on the plate'). In the third stage, the quantities of all foods were estimated with the aid of commonly used household measures and measurement aids[23]. Lastly, there was a review of the diet recall to verify that all information was recorded correctly. A repeat 24 h recall was collected on a subset (25 %) of the population[23].

Identification of commonly consumed fast foods in New Zealand from the 2008/09 New Zealand Adult Nutrition Survey

For the purposes of the present study, we were only interested in savoury fast-food items. 'Fast food' was defined as savoury food that was reported as being sourced from a fast-food/takeaway outlet or quick-service restaurant in the first stage of the 24 h diet recall. Beverages, cakes, biscuits and puddings sourced from fast-food/takeaway outlets were not included. The foods were ranked by frequency of consumption. Using food descriptions, foods were then categorized into those from chain restaurants or independent outlets.

Determination of Na content of foods from online nutrition information (sixteen food categories)

Nutrition information on the Na content of all savoury fast-food menu items (reported in the 2008/09 NZANS) from

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

chain restaurants were collected from company websites: McDonald's[24], Burger King[25], KFC[26], Domino's[27–31], Hell's Pizza[32], Pizza Hut[33], Subway[34] and Wendy's[35]. The following information was collected on 28 December 2013 for 471 foods: brand, food type, serving size (g), Na (mg) per serving and per 100 g. When information on the Na content (such as 'Sodium (mg) per 100 g') was not available, this was calculated using available information. Where several serving sizes were available (e.g. 'small', 'medium' and 'large'), information on a 'medium' serving was recorded. Foods from online nutrition information were categorized into sixteen food categories: (i) burgers; (ii) pizza; (iii) sandwiches; (iv) wraps; (v) breakfast muffins; (vi) garlic bread; (vii) fries/wedges; (viii) hash browns; (ix) stuffed potatoes; (x) potatoes and gravy; (xi) fried chicken; (xii) salads; (xiii) salad dressings/sauces; (xiv) onion rings; (xv) omelettes; and (xvi) chilli con carne.

Determination of Na content of foods sourced from independent outlets (twelve food categories)

The twelve most frequently reported fast-food categories from independent outlets (reported in the 2008/09 NZANS) were: (i) hot chips; (ii) battered fish; (iii) hot dogs; (iv) sausage rolls; (v) pies; (vi) fried chicken; (vii) hamburgers; (viii) egg-foo-yung; (ix) butter chicken; (x) sweet and sour pork; (xi) chop suey; and (xii) sushi. The online New Zealand Yellow Pages®[36], New Zealand Yellow Pages® Menu Restaurant Guide[37] and Menumania[38] were used to search for all fast-food outlets supplying the foods in two main cities in New Zealand (Wellington (population = 191 000)[39] and Dunedin (population = 120 000)[39]). Microsoft® Office Excel 2013 random number generator was used to randomly select four outlets from each fast-food category (two from Wellington city and two from Dunedin city). One sample of each food type was purchased from each of the four outlets, resulting in a total of forty-eight meal samples. Samples were purchased from Wellington outlets between 3 February and 7 February 2014, and from Dunedin outlets between 10 February and 15 February 2014. The food was purchased as seasoned by staff and no specific instructions were given about salting or not salting the food.

The chosen method of laboratory Na analysis follows that described in the Official Methods of Analysis of the AOAC INTERNATIONAL[40]. Briefly, food samples were frozen following collection and stored at −18°C until the time of analysis. The samples were then defrosted, weighed and blended to achieve a homogeneous and evenly distributed mixture. The Na content (mg/kg) of each food was determined (on a wet-weight basis) by microwave nitric acid digestion followed by inductively coupled plasma–optical emission spectrometry, and then calculated per 100 g and per serving. A certified Standard Reference Material (National Institute of Standards and Technology Infant Formula®)[41] designed for detecting minerals such as Na in a food matrix was used in daily laboratory analyses for accuracy purposes[40]. All laboratory analyses were conducted within the Department of Human Nutrition, Dunedin. The CV% was calculated for all of the tested products and Standard Reference Material controls (overall Na CV%: 2·48 %). Only results with a CV% within 5 % of the known Na value were included in the analysis.

Comparison with public health recommendations

Descriptive statistics were used to compare the Na content of fast foods from chain restaurants and independent outlets, both within and between food categories, with (where possible) the UK FSA 2012 sodium targets[42].

Estimation of Na intake from savoury fast foods for the New Zealand adult population

In order to estimate Na intake from fast foods, an Na value per 100 g was assigned to each savoury fast food reported in the 2008/09 NZANS. One of three sources was used: (i) the New Zealand Food Composition Database[43]; (ii) laboratory-tested Na values; or (iii) company online nutrition information Na values. The Na value from the New Zealand Food Composition Database was used in the first instance but if the Na values were ≥10 years old or not from Australia or New Zealand, either the laboratory data or online nutrition information was used (depending on where the fast food was sourced). As it was not collected within the 24 h diet recall, information on salt added to the foods by participants was not available.

Statistical analysis

Data were calculated as Na per serving and Na per 100 g. Where the purchased serving sizes were substantially larger than those reported in the 2008/09 NZANS (this was applicable for hot chips, battered fish, egg-foo-yung, butter chicken, sweet and sour pork, chop suey, sushi and pizza), these were also calculated as 'per serving' using mean serving sizes reported in the 2008/09 NZANS (see online supplementary material, Supplemental Table 1). For each food category the mean Na concentration and range were calculated to show the full range of Na concentration across the different food categories.

Data were analysed using the statistical software package Stata 12·1. For the analysis of the 2008/09 NZANS, survey commands were used to allow for the complex survey design, enabling weighting to be applied so that the results were representative of the New Zealand population at the time of the survey. Na intakes from savoury fast foods were calculated for the adult population (n 4721) and for fast-food consumers (n 1076) by sex, age and ethnicity. Separate linear regression models were constructed for males and females to examine differences in Na intake from fast food, firstly by age group and secondly by ethnic group with age as a covariate. P values < 0·05 were deemed to be statistically significant. Where skewed distributions occurred, the results are

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

Table 1 Mean sodium content of fast foods from New Zealand chain restaurants and UK FSA sodium targets

Fast food	*n*	Serving size (g)		Na (mg/serving)		Na (mg/100 g)		UK FSA 2012 target (mg/100 g)*
		Mean	Range	Mean	Range	Mean	Range	
Burgers†	71	219	92–435	1026	401–1774	478	241–760	300
Pizza	200	78	50–116	426	107–691	557	137–920	500
Sandwiches†	26	201	102–290	716	35–1260	351	186–558	400
Wraps†	29	215	108–300	876	346–1450	416	260–547	400
Breakfast muffins	18	167	60–291	744	313–1444	447	279–582	400
Garlic bread	3	45	28–60	252	201–312	554	520–619	480
Fries/wedges‡	9	219	98–400	660	39–1820	281	45–520	200
Hash browns	2	88	56–120	328	11–919	390	340–440	200
Stuffed potatoes	6	311	57–445	451	251–919	210	4–665	200
Mashed potato and gravy‡	1	125	137–137	400	332–438	320	320–320	200
Fried chicken	15	93	25–225	570	100–1336	617	400–848	300
Salads	24	269	71–400	419	4–1128	139	4–404	N/A
Salad dressings/sauces	34	30	7–134	179	6–679	728	2–3857	663
Omelettes	6	123	94–165	451	227–745	362	256–452	N/A
Onion rings‡	3	115	91–135	445	146–630	392	346–441	N/A
Chili con carne	2	179	170–340	703	114–1292	525	380–671	250
Meal combinations§								
Burger and fries/wedges	80	439	190–835	1686	440–3594			
Pizza and fries/wedges	209	298	148–516	1086	146–2511			
Fries/wedges and sauce	43	249	105–534	839	45–2499			
Pizza and garlic bread	203	124	78–176	678	308–1003			
Breakfast muffin and hash brown	20	255	116–171	1072	324–2363			
Mashed potato and gravy and fried chicken	16	218	138–362	970	432–1774			
Fried chicken and fries/wedges	24	312	123–625	1230	139–3156			
Salad and salad dressing/sauce	58	299	78–534	598	10–1807			

n, number of foods from online nutrition information; FSA, Food Standards Agency; N/A, not applicable.
*UK FSA 2012 sodium targets set for specific food categories[42] (where N/A is stated, there is no set target for the food category).
†Includes all types (e.g. chicken, beef, ham, egg, vegetables and sauce).
‡Where several serving sizes were available (e.g. 'small', 'medium' and 'large'), a 'medium' serving was reported.
§Calculated by adding together food category means and ranges.

reported as both the mean (95 % confidence interval) and median (interquartile range) in the descriptive analysis.

Results

Na content of foods from online nutrition information

The mean Na per serving and per 100 g for fast foods and meal combinations available from chain restaurants is shown in Table 1. The fast-food category with the highest Na per serving was burgers (1026 mg/serving), which was 45 % of the recommended UL. However, when the serving sizes reported in the 2008/09 NZANS were used instead of those used in the online nutrition information, a serving of pizza provided more Na (1276 mg) than a burger and provided 55 % of the recommended UL. Salad dressings/sauces and fried chicken had the highest Na per 100 g (728 mg/100 g and 617 mg/100 g, respectively). The Na content of fast foods within the same food category varied; for example, one pizza sample had 137 mg Na/100 g, while another pizza sample (with similar toppings) had 920 mg Na/100 g. Twelve out of thirteen of the fast-food categories exceeded the UK FSA 2012 sodium targets, some more than 1·5 times (burgers, mashed potato and gravy, fried chicken and chilli con carne).

Na content of foods from independent outlets

The mean Na per serving (as purchased), per 100 g and potential meal combinations for fast foods from independent fast-food outlets are shown in Table 2. The fast-food category with the highest Na per serving was a meal of chop suey (3086 mg/serving), which contained over three times more Na than a meal of fish and chips (941 mg/serving) and provided 134 % of the recommended UL. However this reflected the large serving size, and when adjusted using serving sizes derived from the 2008/09 NZANS data, chop suey contained only half as much Na per serving (670 mg/serving) as sausage rolls (1263 mg/serving), beef hamburgers (1161 mg/serving) and mince and cheese pies (1068 mg/serving). Sausage rolls, battered hotdogs and mince and cheese pies were the highest in Na per 100 g (689 mg/100 g, 679 mg/100 g and 522 mg/100 g, respectively). There was wide variation in the Na content for the same food sourced from different outlets; for example, the range for egg-foo-yung was 159–418 mg/100 g. Ten of the twelve fast foods exceeded the UK FSA 2012 sodium targets, some by more than 1·5 times (sausage rolls, hamburgers, egg-foo-yung and sushi).

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

Table 2 Mean sodium content of fast foods analysed in the laboratory from independent New Zealand fast-food outlets and UK FSA sodium targets

		Serving size (g)*		Na (mg/serving)		Na (mg/100 g)		
Fast food	*n*	Mean	Range	Mean	Range	Mean	Range	UK FSA 2012 target† (mg/100g)
Hot chips‡	5‖	321	178–362	628	297–1242	246	82–699	200
Battered fish	4	153	96–209	313	220–408	222	107–337	200
Sausage rolls	4	184	158–199	1263	1189–1355	689	631–753	450
Mince and cheese pies	4	201	158–237	1068	737–1626	522	446–687	450
Coated fried chicken	4	209	106–294	746	417–1247	365	233–551	300
Beef hamburgers	4	240	207–309	1161	903–1445	499	371–699	300
Battered hotdogs	4	116	103–134	786	636–938	679	565–810	550
Sushi‡	6	381	281–556	1033	791–1313	288	177–374	200
Egg-foo-yung	4	595	340–887	1994	542–2963	317	159–418	200
Butter chicken	4	635	448–819	1523	739–2593	231	165–317	250
Sweet and sour pork (battered)	4	662	557–800	1355	1053–1657	210	132–249	250
Chop suey	4	760	600–914	3086	2011–3444	397	335–512	250
Meal combinations§								
Battered fish and hot chips	9	474	274–571	941	517–1650			
Battered hotdog and hot chips	9	437	294–496	1414	933–2180			
Beef hamburger and hot chips	9	561	385–671	1789	1200–2687			
Fried chicken and hot chips	9	529	284–656	1374	714–2489			

n, number of foods sampled; FSA, Food Standards Agency.
*As purchased.
†UK FSA 2012 sodium targets set for specific food categories[42].
‡Includes samples with and without sauce.
§Calculated by adding together food category means and ranges.
‖Value excludes one sample outlier (699 mg Na/100 g).

Table 3 Mean daily Na intake from savoury fast foods among fast-food consumers (*n* 1076), taking into account sodium concentration, frequency of consumption and serving size reported in the 2008/09 New Zealand Adult Nutrition Survey

	Fast-food consumers reporting foods from food category			Na intake (mg/d) for fast-food consumers*	
Food category	*n*	%	95 % CI	Mean	95 % CI
Potato dishes†	521	43	38, 47	161	136, 187
Filled rolls	218	24	20, 27	183	136, 229
Hamburgers	173	14	11, 17	194	130, 257
Fish‡	169	14	13, 17	121	84, 158
Rice-based dishes	114	10	7, 12	44	24, 64
Fried chicken	130	10	7, 12	76	49, 102
Stir fry§	97	9	7, 12	24	14, 33
Pizza	84	8	5, 10	129	77, 181
Pies	80	8	5, 5	70	41, 98
Sushi	39	5	2, 7	25	13, 36
Egg dishes	46	4	2, 6	17	7, 28
Noodle-based dishes	65	4	2, 5	30	18, 41
Curry	32	3	1, 4	24	11, 38
Deep-fried entrees‖	26	2	1, 4	10	3, 16
Pasta dish	7	0	0, 9	3	0, 6

n, number of individuals.
*Excludes non-reporters of fast foods.
†Includes hot chips/fries/wedges, hash browns, stuffed potatoes, mashed potato and gravy.
‡Includes mostly battered fish.
§Meat and vegetable based (no rice/noodles).
‖Includes samosas, dumplings, spring rolls, wontons and dumplings.

Na intake from savoury fast foods for the New Zealand adult population

Overall, 1076 (23 %) of participants consumed a savoury fast food in the 24 h recall of the 2008/09 NZANS. The mean daily Na intake from savoury fast foods for all adults was 283 mg/d (*n* 4721) and 1229 mg/d for fast-food consumers (*n* 1076). The mean daily Na intake from savoury fast foods among fast-food consumers (taking into account Na concentration, frequency of consumption and serving size reported in the 2008/09 New Zealand Adult Nutrition Survey) is shown in Table 3. Among fast-food consumers, 43 % reported consuming potato dishes and 24 % reported consuming filled rolls. Both hamburgers and battered fish were reported by 14 % of fast-food consumers. The mean Na intake for fast-food consumers was 194 mg from hamburgers, 183 mg from filled rolls, 161 mg from potato dishes and 129 mg from pizza.

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

The mean (95 % confidence interval) and median (interquartile range) Na intake from savoury fast foods for New Zealand adults (by sex, age and ethnicity) are shown in Table 4. Significant differences ($P < 0{\cdot}001$) in mean Na intake from savoury fast foods among the total adult population and fast-food consumers were found by sex and age, but not by ethnicity ($P > 0{\cdot}05$). Among the adult population and fast-food consumers (males and females), the 15–18 year old age group had significantly ($P < 0{\cdot}001$) higher mean Na intakes from savoury fast foods compared with those aged 51–70 years and ≥71 years.

Discussion

The present study is the first of its kind to examine Na levels in commonly consumed savoury fast foods in New Zealand and to apply this information to national data to enable estimates of Na intake from fast foods. We found high Na levels, in comparison to the UK FSA 2012 sodium targets, for the majority of commonly consumed fast foods in New Zealand. Burgers, pizza, sausage rolls and pies had relatively high Na content per serving compared with other savoury fast foods. Most food categories

Table 4 Mean and median sodium intake from savoury fast foods (among the total adult population and fast-food consumers*) taking into account sodium concentration, frequency of consumption and serving size reported in the 2008/09 NZANS, by sex, age and ethnicity

	Sex	Age/ethnicity†	*n*	Mean Na (mg/d)	95 % CI	Overall *P* value‡	Median Na (mg/d)	IQR
Total sample			4721	283	250, 315		0	0–0
	Males		2066	384[a]	324, 444		0	0–112
		15–18 years		589[b]	406, 772		0	0–865
		19–30 years		758[a]	550, 965		0	0–1217
		31–50 years		356[c]	273, 440		0	0–88
		51–70 years		189[c]	92, 285		0	0–0
		≥71 years		70[c]	43, 97		0	0–0
						$P < 0{\cdot}001$		
		Māori		515[a]	363, 667		0	0–887
		PI		360[a]	255, 465		0	0–434
		NZEO		365[a]	298, 432		0	0–0
						$P = 0{\cdot}189$		
	Females		2655	190[a]	162, 217		0	0–0
		15–18 years		339[b]	249, 429		0	0–436
		19–30 years		293[a]	219, 368		0	0–242
		31–50 years		204[a]	153, 256		0	0–0
		51–70 years		109[c]	75, 144		0	0–0
		≥71 years		45[c]	24, 66		0	0–0
						$P < 0{\cdot}001$		
		Māori		250[a]	190, 310		0	0–305
		PI		261[a]	193, 330		0	0–366
		NZEO		179[a]	148, 211		0	0–0
						$P = 0{\cdot}036$		
Fast-food consumers*		1076		1229	1126, 1332		952	503–1586
	Males		512	1467[a]	1296, 1639		1118	629–1901
		15–18 years		1741[b]	1420, 2062		1406	838–2319
		19–30 years		1716[a]	1359, 2072		1342	766–2244
		31–50 years		1340[c]	1133, 1548		1077	619–1744
		51–70 years		1160[c]	659, 1663		902	440–1200
		≥71 years		944[c]	744, 1144		806	554–1195
						$P < 0{\cdot}001$		
		Māori		1582[a]	1360, 1803		1544	715–2315
		PI		1460[a]	1164, 1756		1099	566–2015
		NZEO		1435[a]	1230, 1640		1076	628–1758
						$P = 0{\cdot}607$		
	Females		564	945[a]	859, 1031		804	416–1274
		15–18 years		1059[b]	842, 1276		815	454–1255
		19–30 years		1079[a]	901, 1257		933	619–1439
		31–50 years		984[a]	825, 1144		844	355–1367
		51–70 years		697[c]	554, 840		522	283–1017
		≥71 years		618[c]	509, 727		545	421–775
						$P < 0{\cdot}001$		
		Māori		1008[a]	892, 1124		886	482–1458
		PI		1041[a]	885, 1197		859	516–1482
		NZEO		936[a]	827, 1046		775	366–1195
						$P = 0{\cdot}515$		

NZANS, New Zealand Adult Nutrition Survey; *n*, number of individuals; IQR, interquartile range; PI, Pacific Island ethnicity; NZEO, New Zealand European and Others (mainly Asian, Middle Eastern, Latin American and African ethnicities[54]).
[a,b,c]Mean values within a column with unlike superscript letters were significantly different ($P < 0{\cdot}001$).
*Excludes non-reporters of savoury fast foods in the 2008/09 NZANS.
†In the 2008/09 NZANS there was oversampling of particular subgroups of the population: Māori and Pacific ethnic groups and some age groups (15–18 years and ≥71 years).
‡Overall *P* value from the Wald test.

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

showed a wide range of Na concentration. For example, pizzas ranged from 137 to 920 mg Na/100 g and burgers ranged from 241 to 760 mg Na/100 g. This suggests that there is no technical reason preventing Na reduction in savoury fast foods to levels at the lower end of the existing range[8,44].

The present study also shows that savoury fast food contributes substantially to population Na intake, particularly among young adults under 30 years. Potato dishes, filled rolls, hamburgers and battered fish were important contributors to Na intakes for fast-food consumers when both the Na concentration and the frequency of consumption were taken into account. They should therefore be targets for intervention in order to achieve meaningful reductions in Na intake from savoury fast foods. These results are not surprising given that hot chips/fries/wedges are an accompaniment to most fast-food meals in New Zealand and bread forms the base of many fast-food types (such as hamburgers, filled rolls and pizza bases)[10].

High Na/salt levels in fast foods have been widely reported. The salt content of fast foods has been found to be high in the UK and the USA, where the average takeaway meal has been found to contain more than half of the UK population intake (2009) target of 6 g salt/d (2300 mg Na/d)[6,7]. Such high salt levels of fast foods may be attributed to large serving sizes as well as a high Na concentration within the foods. Jaworowska *et al.* analysed purchased takeaway food in the UK and found that pizzas (the fast-food item with the highest salt content per serving) ranged from 6·97 to 12·83 g of salt (2742 to 5047 mg of Na) per serving, with the serving size ranging from 559 to 781 g[7]. Items such as pizza and burgers typically comprise bread, processed meats, cheese and sauces, all of which tend to be high-Na ingredients[45]. Most studies also show large variation within the same food categories[8,44] and fast-food items marketed as the same product in six different countries have been found to have very different Na contents[11,46]. Food sources that are the highest in Na content may not, however, be the most important sources of dietary Na at a population level because they may not be frequently consumed[1], and dietary patterns differ between countries and populations. For example, in the USA, pizza, chicken, burgers and Mexican dishes have been found to be the top items reported outside the home (providing 7·8 % of total Na in adult diets)[47]. This highlights the importance of using population-specific data to inform public health reformulation strategies.

Salt reduction in foods has been proven feasible in the UK and Finland[48], and it has been found that a reduction of up to one-third in the Na content of foods can be made before the sensory acceptability of food is affected[49]. Changes may go unnoticed if reductions are made 'little and often'[20]. Specifying voluntary Na content targets across a wide range of food categories may encourage sectors of the food industry to carry out reformulation work to reduce the Na content of their products. Although New Zealand lacks a wide range of specific Na targets, some companies have already committed to reformulation[50]. One example is 'The Chip Group' (formed by the partnership of the New Zealand Heart Foundation, the New Zealand Ministry of Health, New Zealand potato growers, chip manufacturers and oil suppliers) which encourages the food industry to use salt sparingly when added as a seasoning, or to use salt sachets so that consumers can control the amount of salt added to their chips[51]. Participation in such an initiative is likely to have large benefits among fast-food consumers, given that such a large percentage of consumers reported consuming potato dishes. Further reductions in the Na concentration in bread could impact on the Na content of filled rolls and hamburgers, which we also found to be large contributors to Na intake. Mandatory reformulation targets, such as those recently implemented in South Africa and Argentina, would provide a level playing field to ensure that companies are not penalised commercially for lowering the Na content of their foods[19,52]. In addition to reformulation, greater diversity in fast-food menus could encourage the selection of lower-Na options and these could be easily identified by including 'at a glance' nutrition information on fast-food packaging[53].

Strengths/limitations and implications for future research

There were aspects of the present study which add strength to our findings. It is the first New Zealand study to apply Na nutrition information to survey data to enable estimates of dietary Na intake from fast foods. Our study provides information on the Na content of fast foods from both chain restaurants and independent outlets. Furthermore, the food sampling protocol was informed from fast-food choices from a large national sample; therefore the foods chosen for laboratory analysis were representative of dietary choices of New Zealanders. We re-calculated as-purchased large serving sizes using average portion sizes sourced from the 2008/09 NZANS to provide realistic serving sizes. In the laboratory, a Standard Reference Material with an acceptable CV% was used and this guaranteed the accuracy of our results. Our results can therefore be used as a benchmark for future monitoring of trends in Na levels of savoury fast foods over time.

A number of limitations also exist. We have estimated Na intake from savoury fast foods for the adult population; however (i) data collected did not include discretionary salt which could be added by consumers at the table; (ii) additions to foods (such as sauces) could be made by participants at home and therefore these were not always coded as being from a fast-food outlet; and (iii) we have not captured all types of fast foods prepared outside the home (as fast-food items such as pies sourced from small local shops and supermarkets were not coded in the survey as being sourced from a fast-food outlet)[10]. We therefore may have underestimated the population Na

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

intake from savoury fast food. In order to estimate the Na content of fast foods from chain restaurants, we used published Na values from online nutrition information, and there was variation in whether Na reported included salt added just before serving. For food sources from independent outlets, only four samples were used in laboratory analysis to represent each food type and samples were collected from just two centres (Dunedin and Wellington). These results therefore may not be an accurate representation of foods available across the New Zealand market. Future research in this area could include larger sample sizes of foods and collection of samples from other urban and rural settings.

Conclusion

Savoury fast food is an important contributor to New Zealand population Na intake and the variability of Na content within food categories shows that Na reduction in many items is feasible. Taking into account both the Na content and frequency of consumption, potatoes, filled rolls, hamburgers and battered fish were the most important contributors to Na intake from savoury fast food for consumers in New Zealand. New Zealand should implement a coordinated government-led population salt reduction strategy which includes reformulation guided by targets across a wide range of food categories including savoury fast foods. This approach has the greatest potential to achieve the WHO 30 % reduction in population salt intake and thereby prevent significant morbidity and mortality in future years.

Acknowledgements

Acknowledgements: The authors would like to thank A. Duncan, K. Bailey, K. Columb and M. Harper (Department of Human Nutrition, University of Otago) for their laboratory assistance and advice. *Financial support:* Some of the data used in this study were from the 2008/09 New Zealand Adult Nutrition Survey. The New Zealand Ministry of Health funded the 2008/09 New Zealand Adult Nutrition Survey and the survey was conducted collaboratively with the University of Otago. The New Zealand Ministry of Health had no role in the design, analysis or writing of this work. The New Zealand Crown is the owner of the copyright for the survey data. The results presented in this paper are the work of the authors. *Conflict of interest:* The authors declare no conflict of interest. *Authorship:* R.M.M. and C.S. formulated the research questions and designed the study; C.A.P. collected food samples and carried out the laboratory analyses/obtained online Nutrition Information Panel data; C.A.P., R.M.M. and C.S. analysed and interpreted the results; R.M.M. and C.S. conducted statistical analyses; C.A.P. drafted the manuscript; R.M.M. and C.S. contributed to the final manuscript. *Ethics of human subject participation:* The 2008/09 New Zealand Adult Nutrition Survey was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the New Zealand Health and Disability Multi-Region Ethics Committee (MEC/08/04/049). Written informed consent was obtained from all participants.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980015001731

References

1. Henney JE, Taylor CL & Boon CS (2010) *Strategies to Reduce Sodium Intake in the United States*. Washington, DC: National Academies Press.
2. He FJ & MacGregor GA (2005) Salt in food. *Lancet* **365**, 844–845.
3. Van Raaij J, Hendriksen M & Verhagen H (2009) Potential for improvement of population diet through reformulation of commonly eaten foods. *Public Health Nutr* **12**, 325–330.
4. Webster JL, Dunford EK & Neal BC (2010) A systematic survey of the sodium contents of processed foods. *Am J Clin Nutr* **91**, 413–420.
5. Keogh JB, Lange K, Hogarth R *et al.* (2013) Foods contributing to sodium intake and urinary sodium excretion in a group of Australian women. *Public Health Nutr* **16**, 1837–1842.
6. Johnson CM, Angell SY, Lederer A *et al.* (2010) Sodium content of lunchtime fast food purchases at major US chains. *Arch Intern Med* **170**, 732–734.
7. Jaworowska A, Blackham T, Stevenson L *et al.* (2012) Determination of salt content in hot takeaway meals in the United Kingdom. *Appetite* **59**, 517–522.
8. Heredia-Blonval K, Blanco-Metzler A, Montero-Campos M *et al.* (2014) The salt content of products from popular fast-food chains in Costa Rica. *Appetite* **83**, 173–177.
9. De Vogli R, Kouvonen A & Gimeno D (2014) The influence of market deregulation on fast food consumption and body mass index: a cross-national time series analysis. *Bull World Health Organ* **92**, 99–107A.
10. Smith C, Gray AR, Fleming EA *et al.* (2014) Characteristics of fast-food/takeaway-food and restaurant/café-food consumers among New Zealand adults. *Public Health Nutr* **17**, 2368–2377.
11. Levings J-L & Gunn JP (2014) From menu to mouth: opportunities for sodium reduction in restaurants. *Prev Chronic Dis* **11**, E13.
12. Australian Department of Health and Ageing, National Health and Medical Research Council & New Zealand Ministry of Health (2006) *Nutrient Reference Values for Australia and New Zealand*. Canberra: Australian Department of Health and Ageing and New Zealand Ministry of Health.
13. Skeaff SA, McLean R, Mann J *et al.* (2013) *The Impact of Mandatory Fortification of Bread with Iodine*. Wellington: Ministry for Primary Industries.
14. World Health Organization (2013) *Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020*. Geneva: WHO.
15. He FJ, Li J & Macgregor GA (2013) Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. *BMJ* **346**, f1325.

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.

16. Lim SS, Vos T, Flaxman AD *et al.* (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* **380**, 2224–2260.
17. He FJ & MacGregor GA (2009) A comprehensive review on salt and health and current experience of worldwide salt reduction programmes. *J Hum Hypertens* **23**, 363–384.
18. Bibbins-Domingo K, Chertow GM, Coxson PG *et al.* (2010) Projected effect of dietary salt reductions on future cardiovascular disease. *N Engl J Med* **362**, 590–599.
19. Webster J, Trieu K, Dunford E *et al.* (2014) Target salt 2025: a global overview of national programs to encourage the food industry to reduce salt in foods. *Nutrients* **6**, 3274–3287.
20. He FJ, Brinsden HC & MacGregor GA (2014) Salt reduction in the United Kingdom: a successful experiment in public health. *J Hum Hypertens* **28**, 345–352.
21. New Zealand Heart Foundation (2014) Case Study 1: Project Target 450. http://www.heartfoundation.org.nz/programmes-resources/food-industry-and-hospitality/heartsafe/case-studies-resources/case-study-1-project-target-450 (accessed December 2014).
22. Heart Foundation (2014) HeartSAFE. http://www.heartfoundation.org.nz/programmes-resources/food-industry-and-hospitality/heartsafe (accessed May 2014).
23. University of Otago & Ministry of Health (2011) *Methodology Report for the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: University of Otago & Ministry of Health.
24. McDonald's Restaurants (NZ) Limited (2013) McDonald's Restaurants New Zealand Nutrition Information. https://mcdonalds.co.nz/sites/mcdonalds.co.nz/files/nz_master_nutrition_information_14_november_2013.pdf (accessed December 2013).
25. Burger King Corporation (2013) Your Meal. Your Life. Your Way. http://burgerking.co.nz/pdf/Burger%20King%20Nutritional%20Information.pdf (accessed December 2013).
26. KFC (2013) New Zealand: KFC so good. http://www.kfc.co.nz/files/documents/rb0329-kfc-nutritional-brochure-170613/ (accessed December 2013).
27. Domino's Pizza Enterprises Ltd (2013) Nutritional Information New Zealand Chefs Best Range. http://www.dominospizza.co.nz/media/347225/chefs-best-range-feb-2014-nz.pdf (accessed December 2013).
28. Domino's Pizza Enterprises Ltd (2013) Nutritional Information New Zealand Traditional Range. http://www.dominospizza.co.nz/media/347223/traditional-range-feb-2014-nz.pdf (accessed December 2013).
29. Domino's Pizza Enterprises Ltd (2013) Nutritional Information New Zealand Value Range. http://www.dominospizza.co.nz/media/347222/value-range-feb-2014.pdf (accessed December 2013).
30. Domino's Pizza Enterprises Ltd (2013) Nutritional Information New Zealand Value Plus Range. http://www.dominospizza.co.nz/media/347219/value-plus-range-feb-2014-nz.pdf (accessed December 2013).
31. Domino's Pizza Enterprises Ltd (2013) Nutritional Information New Zealand Sides Range. http://www.dominospizza.co.nz/media/347220/sides-range-feb-2014-nz.pdf (accessed December 2013).
32. Hell's (2013) Nutritional Information New Zealand. http://hellpizza.com/files-nz/documents/Hell_Nutritional_Info.pdf (accessed December 2013).
33. Pizza Hut (2013) Nutritional Information New Zealand. http://www.0800838383.co.nz/nutritional_info.pdf (accessed December 2013).
34. Subway New Zealand (2013) Nutrition Information New Zealand. http://www.subway.co.nz/menunutrition-1/nutrition-information-guides (accessed December 2013).
35. Wendy's Old Fashioned Hamburgers (2013) Nutritional Information New Zealand. http://www.wendys.co.nz/our-food/nutritional (accessed December 2013).
36. Yellow (2014) Home page. http://yellow.co.nz/ (accessed January 2014).
37. Yellow Menus Restaurant Guide (2014) Home page. http://www.menus.co.nz/ (accessed January 2014).
38. Menumania (2014) Home page. http://www.menumania.co.nz (accessed January 2014).
39. Statistics New Zealand (2013) 2013 Census Usually Resident Population Counts. http://www.stats.govt.nz/browse_for_stats/population/ census_counts/2013CensusUsuallyResidentPopulationCounts_HOTP2013Census/Commentary.aspx (accessed April 2014).
40. Official Methods of Analysis of AOAC INTERNATIONAL (1997) *Food Composition; Additives; Natural Contaminants*, 16th ed. Rockville, MD: AOAC INTERNATIONAL.
41. National Institutes of Standards & Technology (1999) *Standard Reference Material 1946: Infant Formula*. Gaithersburg, MD: NIST, Division AC.
42. Food Standards Agency (2009) Agency publishes 2012 salt reduction targets. http://webarchive.nationalarchives.gov.uk/20120206100416/http://food.gov.uk/news/newsarchive/2009/may/salttargets (accessed March 2014).
43. New Zealand Institute for Plant and Food Research Ltd & Ministry of Health (2014) New Zealand Food Composition Database. http://www.foodcomposition.co.nz/ (accessed December 2013).
44. Kanzler S, Hartmann C, Gruber A *et al.* (2014) Salt as a public health challenge in continental European convenience and ready meals. *Public Health Nutr* **17**, 2459–2466.
45. Thomson BM, Vannoort RW & Haslemore RM (2008) Dietary exposure and trends of exposure to nutrient elements iodine, iron, selenium and sodium from the 2003–4 New Zealand Total Diet Survey. *Br J Nutr* **99**, 614–625.
46. Dunford E, Webster J, Woodward M *et al.* (2012) The variability of reported salt levels in fast foods across six countries: opportunities for salt reduction. *CMAJ* **184**, 1023–1028.
47. Drewnowski A & Rehm CD (2013) Sodium intakes of US children and adults from foods and beverages by location of origin and by specific food source. *Nutrients* **5**, 1840–1855.
48. Webster JL, Dunford EK, Hawkes C *et al.* (2011) Salt reduction initiatives around the world. *J Hypertens* **29**, 1043–1050.
49. Adams SO, Maller O & Cardello AV (1995) Consumer acceptance of foods lower in sodium. *J Am Diet Assoc* **95**, 447–453.
50. Gorton D, Jayasinha N & Monro D (2010) Salt reduction in New Zealand: are we keeping up with Australia? *N Z Med J* **123**, 102–104.
51. The Chip Group (2014) Salt Addition: Not too much salt. http://blog.thechipgroup.co.nz/industry-standards-2/salt-addition-2/ (accessed December 2014).
52. Institute of Medicine (2010) Strategies to reduce sodium intake in the United States. *Report Brief*, April 2010 issue. Washington, DC: The National Academies Press; available at http://www.ncbi.nlm.nih.gov/books/NBK50956/
53. McLean RM, Mann JI & Hoek J (2011) World Salt Awareness Week: more action needed in New Zealand. *N Z Med J* **124**, 68–76.
54. University of Otago & Ministry of Health (2011) *A Focus on Nutrition: Key findings of the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: University of Otago & Ministry of Health.

Downloaded from https://www.cambridge.org/core. 16 Sep 2026 at 21:31:23, subject to the Cambridge Core terms of use.